

# Nutrient Criteria for Lakes: Proposed Rule and Rationale

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# Previously Proposed Criteria

	TP (µg/L)	TN (µg/L)	Chl-α (µg/L)
Plains	50	1000	10.0
Ozarks	20	500	6.0

Based on Lines of Evidence developed by

- EPA
- RTAG
- MDNR

# Objections

- Limits would be detrimental to fish populations.
- Linkage to Aquatic Life Designated Use was not clear.

MDNR requested UMC and MDC staff to make recommendations for response variables based on their research.

# UMC, MDC Recommendations

	Chl- $\alpha$ ( $\mu\text{g/L}$ )	Secchi Depth (m)
Plains	30	0.6
Ozark Border	22	0.7
Ozark Highland	15	0.9

# Rationale

- Globally, fish biomass and production increase with increasing TP and Chl- $\alpha$ .
- Nutrient reductions have led to declines in sport fisheries.
- MDC study (2012): In small impoundments (<1000 ac), ideal Chl- $\alpha$  range for sport fisheries is 40-60  $\mu\text{g/L}$ .

# Missouri Lake Classification

- L1: Lakes used primarily for drinking water supply
- L2: Major reservoirs
- L3: All other lakes which are waters of the state

# The Central Conflict

## Fisheries:

More healthy at higher trophic levels (eutrophic)

## Whole Body Contact:

Lower trophic level is desirable

## Drinking Water:

Lower trophic level is necessary



# How to Resolve?

## Consider Lake Classification

Class	General Characteristics and Issues	Approach
L1	Excessive algae blooms can and do impair drinking water quality and strain water treatment systems	Criteria need to protect against high algae bloom frequency.
L2	Wide variety of uses. Trophic levels are lower at outlet and higher in upper reaches and tributary arms.	Since wq sampling is from near dam, it needs to be more protective.
L3	Generally smaller and managed to optimize fisheries.	Allow higher nutrient concentration, but not so high as to risk hyper-eutrophy.



# Deriving Nutrient Criteria

- Chl- $\alpha$  is parameter of primary concern
  - Controls frequency of algae blooms
  - Associated with taste and odor (and sometimes health) issues in drinking water
  - Affects lake aesthetics
- TN and TP
  - Primary (but not only) factors controlling Chl- $\alpha$  concentration

## Selecting Chl- $\alpha$ Levels

- L1: Literature review indicates that 10  $\mu\text{g/L}$  is a threshold level above which impairment risk rises exponentially
- L2: Based on previously presented lines of evidence, with some modification
- L3: Based on recommendations from UMC and MDC

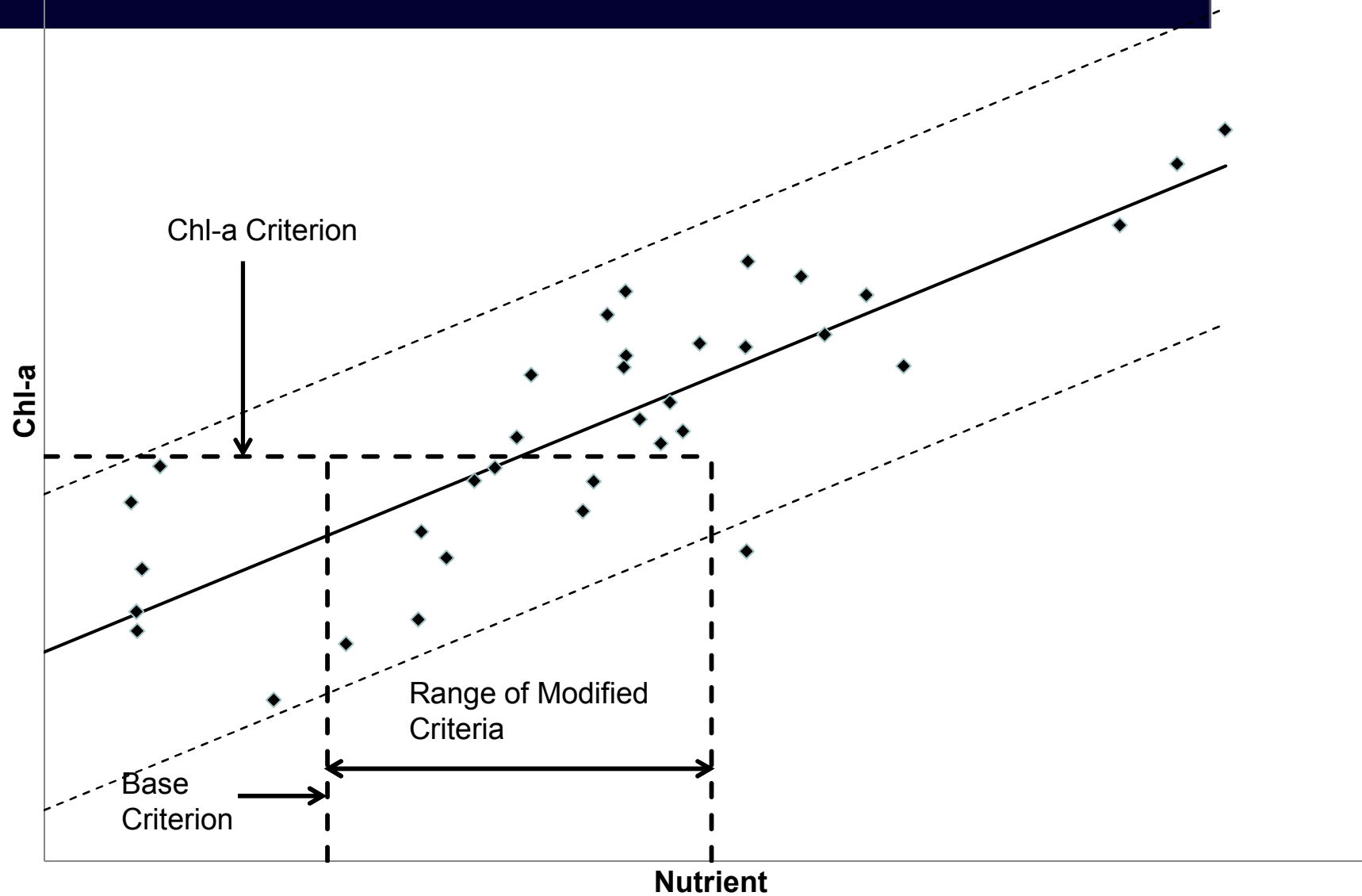
# Criteria Values

- Based on EPA – Florida model
- General Ecoregional – Limits for TN, TP, and Chl- $\alpha$  within each lake ecoregion
- Alternative Ecoregional Criteria – Ranges for TP and TN for lakes that meet Chl- $\alpha$  limit for previous three years
- Site Specific Criteria – Table M

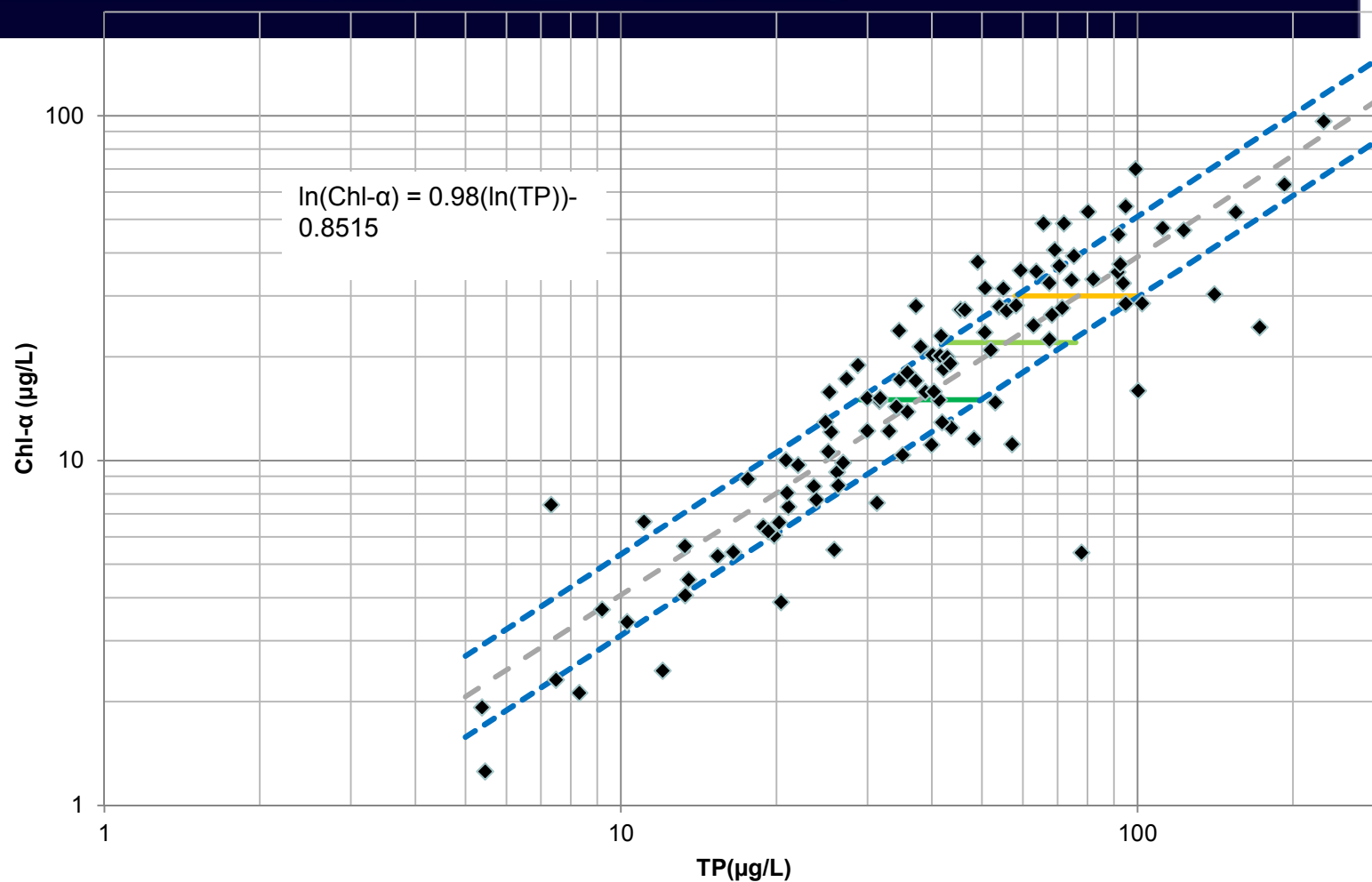
## Total Nitrogen and Total Phosphorus

- Baseline Criteria: 75<sup>th</sup> percentile of predicted Chl- $\alpha$  distribution from regression relationship equivalent to Chl-a criterion for lake class.
- Modified Criteria: Range is from baseline criteria level to point at which Chl- $\alpha$  criterion for lake class is at 25<sup>th</sup> percentile of predicted Chl- $\alpha$  distribution.

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- Criteria: Ozark Highlands
- Criteria: Ozark Border
- Criteria: Plains
- ◆ Lake Geomean Values
- regression line
- - -50% PI
- - +50% PI

Table L: General Ecoregional nutrient criteria (µg/L) [Alternative Criteria in Brackets]

Lake Ecoregion	Lake Class	Chl- $\alpha$	TP	TN
Plains	L1	10.0	20 [20-34]	490 [490-660]
	L2	12.0	29 [29-45]	600 [600-900]
	L3	30.0	58 [58-101]	900 [900-1400]
Ozark Border	L1	10.0	20 [20-34]	490 [490-660]
	L3	22.0	42 [42-76]	700 [700-1100]
Ozark Highlands	L1 & L2	6.0	13 [13-21]	370 [370-500]
	L3	15.0	29 [29-50]	550 [550-850]